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Conservation Systems Research

High-Residue Cover Crops, Crop Rotation, and Tillage System Effects on Soil Compaction and Organic Matter

RESEARCH PROJECT DESCRIPTION NO. 29



Cotton growing in a high residue, conservation tillage system

Researchers

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The Challenge

Soil compaction can seriously reduce cotton yields by restricting root development necessary for nutrient and water uptake. Cotton roots are very sensitive to compacted soil layers and will stop growing downwards when they encounter resistance from a denser layer of soil. When water is limited, this problem is especially damaging to crop success.

Compacted soil layers are common in agricultural soils. The problem can be partially avoided by maintaining or improving the soil organic matter content. Organic matter helps bind soil particles together, improving soil structure and strength, which resist compacting forces. If compacted layers are near the soil surface, they can be disrupted by subsoiling.

In the winter of 2001, a survey of central Alabama cotton fields (Kuykendall, et al., 2002) found that many of them (63% of those surveyed) had hard pans

“... a survey of central Alabama cotton fields found that many of them had serious hard pans within the top 12 inches of soil. ... Seventy-five percent of the fields had less than 0.8% soil organic matter.”

within the top 12 inches of soil. While many of the fields with hard pans had not received subsoiling within the past year, a number of fields that had been in conservation tillage with subsoiling the previous fall did have compacted layers. Apparently, the effects from the fall subsoiling had been lost in less than a year.

Why were some conservation-tilled fields susceptible to compaction? The answer might be organic matter. The 2001 survey found that the soil organic matter content was extremely low. Seventy-five percent (75%) of the fields had less than 0.8% soil organic matter. Half of the fields had less than 0.4% soil organic matter. These organic matter levels are extremely low and have been shown in other studies to be associated with poor soil quality and poor yields. Most fields in this survey did not have winter cover crops,



Cotton root grows sideways after encountering a compacted soil layer

which could provide residue to help increase soil organic matter content with time.

The Experiment

In the autumn of 2003 we initiated an experiment at the Alabama Agricultural Experiment Station at Prattville to evaluate conservation tillage systems and winter cover crops that might increase soil organic matter, reduce soil compaction, and improve cotton and corn profitability. The objectives of the study are to:

- Determine the extent of soil compaction with and without a cover crop for four tillage systems in a cotton-corn rotation.
- Determine the change in organic matter levels for each tillage and cover crop combination.
- Demonstrate the effectiveness of high-residue cover crops.

The experiment consists of a cotton and corn rotation with four tillage systems (no-tillage; fall paratilling; spring paratilling; spring strip-tillage), three winter cover crops (none, rye, and wheat), and four replications. Cover crops will be terminated with herbicides and a roller/crimper at least 4 weeks before planting of summer crops.

Plant data we are evaluating include stand counts, yield, dry matter, carbon, and nitrogen. Soil measurements will include texture, bulk density, water retention, and hydraulic conductivity. Other soil measurements collected in 2-inch depth increments will be carbon, nitrogen, pH, phosphorus, potassium, calcium, magnesium, and micronutrients.

Related Publications

Kuykendall, L., R.R. Beauchamp, and C.C. Mitchell. 2002. Changes in central Alabama cotton soil management, 1991 and 2001. Proc. 2002 Beltwide Cotton Conferences (Cotton Soil Management and Plant Nutrition Conf., Atlanta, GA) National Cotton Council, Memphis, TN.